A CAHNERS PUBLICATION 112 TOTAL PAGES JULY 15, 1990

DATAMATION®

FOR MANAGERS OF INFORMATION TECHNOLOGY WORLDWIDE

GETTING A GRIP ON COSTS

How IS Managers Are Getting Bigger Bangs For the Buck PAGE 20

Also in This Issue:

Imaging: The Challenge of Integration PAGE 27
The AS/400: IBM's Proprietary Paradox PAGE 41
The New Generation of Network Servers PAGE 54
What's Your Strategy for Buying PCs? PAGE 69

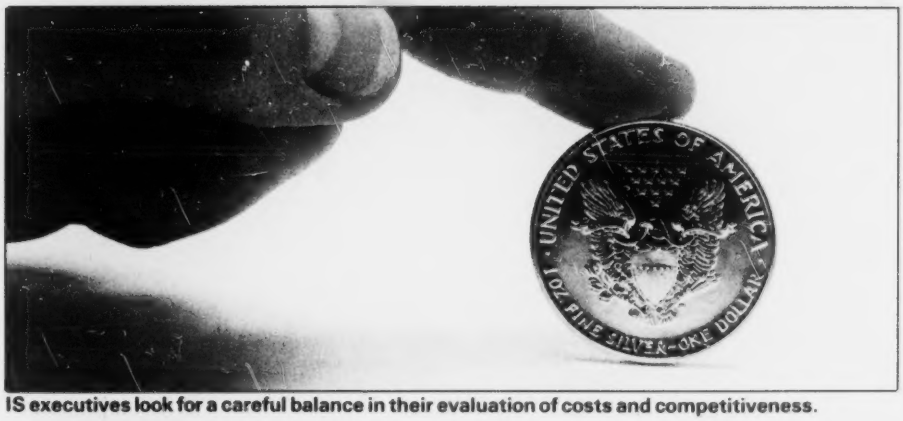
JULY 15, 1990

VOLUME 36
NUMBER 14

DATAMATION

FOR MANAGERS OF INFORMATION TECHNOLOGY WORLDWIDE

COVER STORY



IS executives look for a careful balance in their evaluation of costs and competitiveness.

Getting a Grip on Costs 20

BY RALPH CARLYLE Is the boss on your back about how much your IS department is spending? Can't figure out a way to cut back any further without hurting operations? Relax! The efficiency experts are on the way.

Cover photography by David Bradley

SOFTWARE

IMAGING

The Challenge of Integration 27

BY DAVID STAMPS Image technology keeps getting better, but building image applications remains a considerable challenge. At issue is how to integrate tomorrow's imaging systems with today's business-critical applications.

Bristol-Myers' Gilson is having a tough time finding image systems at departmental prices.

PROFILE

SAS: Architecting an Open Strategy 35

BY PAUL PINELLA For the past six years, SAS Institute has quietly built a $100 million software architecture, and now it's telling the world. But can the company use its new-found flexibility to keep growing in the brave new world of PCs and workstations?

Proctor & Gamble's Esposito applauds SAS' responsiveness to customer needs.

INSIGHTS ON DISTRIBUTED COMPUTING

The Northwest application represents a much broader use of image. Different databases, different data types, expert systems, a number of different software technologies are all tied together at the workstation level using a client/server, open systems architecture.

Bob Castle
FileNet Corp.
PAGE 27

We are reevaluating the role of our mainframe on the network—the SystemPRO could give our Unisys A5 mainframe a run for its money. We will certainly be moving more of the processing onto our network.

Frank Musick
Franke Contract Group
PAGE 54

We're talking about a fairly large piece of the budget in PCs, because a PC is an integrated component. You have to consider the fully bundled costs involved such as software, support, consulting, the controller port, the LAN administration and the chunk of the mainframe.

Peter Daboul
Mass Mutual
PAGE 69

DATAMATION
FOR MANAGERS OF INFORMATION TECHNOLOGY WORLDWIDE

SYSTEMS

MIDRANGE COMPUTERS

IBM's Proprietary Paradox 41

BY CHRIS SIVULA Conventional wisdom holds that IBM's AS/400 cannot compete in a world of open systems and plug-and-play hardware and software. But new data from the 1990 DATAMATION/Cowen & Co. survey suggest otherwise.

PARALLEL PROCESSING

Teradata Revs Up Its Database Machine 49

BY TOM McCUSKER Pioneer database machine builder Teradata thinks it has a better mousetrap for processing big relational databases. Early reports look good, but the company will have to fend off IBM and Japan.

Teradata's Simonds recalls the first database computer produced in 1984.

COMMUNICATIONS

NETWORKING

The New Generation of Network Servers 54

BY LEILA DAVIS Personal computers have been used to facilitate simple file and peripheral sharing, but now a new generation of server hardware is emerging that promises to do much more.

STANDARDS

Measuring OLTP With a Better Yardstick 62

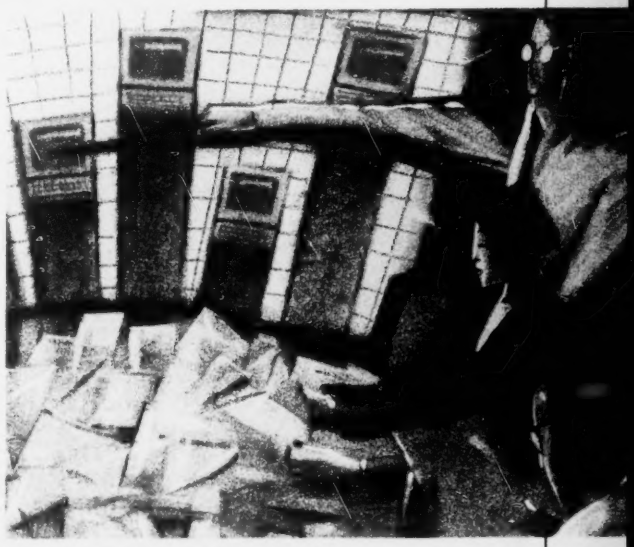
BY OMRI SERLIN The two-year-old Transaction Processing Performance Council is creating a benchmark by setting standards in an area ripe with conflict and disagreement—the sensitive and competitive area of computer performance measurement.

MANAGEMENT

PC PURCHASING

What's Your Strategy For Buying PCs? 69

BY JANETTE MARTIN All those PCs in your company may now represent your largest technology asset. Should you continue to buy or should you lease? And what's to be done with all those older PCs?



CAREER DEVELOPMENT

Learning to Cure Technical Obsolescence 75

BY WILLIAM A. WOODWARD A commitment by IS employees and their employers to ongoing education can help eradicate a lapse in professional development that often strikes professionals after the age of 40.

INTERNATIONAL

FRANCE

A PC Refugee Arises in France 79

BY TREVOR HUGGINS If adversity breeds strength, France's newest personal computer maker, Pekin Stone, promises to be a powerhouse. It's founders won't give up their revolutionary vision.

DEPARTMENTS

Inside DATAMATION	8	Look Ahead	19	Company Index	104
		New Products	85	Ad Index	104
Letters, Access, Planner	12	Career Opportunities	94		

The Challenge Of Integration

Image technology keeps getting better, but building image applications remains a considerable challenge. At issue is how to integrate tomorrow's imaging systems with today's business-critical applications.

BY DAVID STAMPS

Image-processing technology is on a fast track these days. The pace of new product announcements alone should be enough to make information systems managers pay heed. High-resolution monitors that use as many as 3 million pixels to paint pictures of stunning crispness are available. So, too, are faster and cheaper laser printers and scanners. Optical storage subsystems—the generally favored means for storing electronic images—continue to raise the limit for data storage. Sony Corp., for example, offers a 12-inch disc that holds 3.75 gigabytes of data per side. And 5¼-inch optical jukebox systems are proliferating like rabbits.

Data transfer from an optical disc is still slower than from a magnetic disk. But here, too, new advances promise to close the gap between optical and magnetic data speeds. New compression/decompression algorithms can squeeze the image for a standard paper document from one megabyte down to less than 50 kilobytes.

Songs of Solution

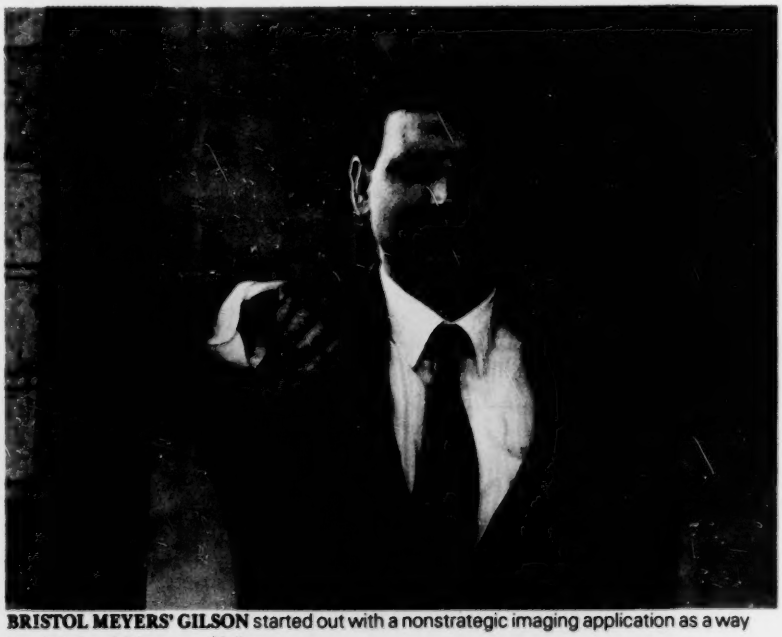
Such an outpouring of technology has the imaging industry bustling with excitement. But what excites many IS pros even more is the fact that it's now possible to tie together these various components into imaging applications that offer enormous returns. Instead of harping on technology, the image industry is suddenly singing songs of solution.

All of this marks a significant change. Not so long ago, imaging was, in the words of one IS director, "a technological curiosity." Image processing tended to be used in stand-alone applications, usually built around the task of document storage and retrieval, an application for which the technology is well suited. But the real returns from imaging won't happen until systems begin to eliminate the physical flow of paper in a company. And without software to replicate work flow or to link imaging to other existing applications built on years of IS effort, an image system is scarcely more than an expensive filing cabinet.

Image systems are starting to live up to their potential to integrate electronic document handling with other business critical applications, however. Consider the case of St. Paul-based Northwest Airlines Inc., which is using image technology to tackle a job that, until recently, defied automation. Northwest, the nation's fourth-largest air carrier, processes over 600 million ticket transactions a year.

The front end of the ticket business is sufficiently automated. Electronic records of every ticket sold by a travel agent or one of Northwest's own 60,000 ticket agents go directly into an IBM mainframe database. The back end of the ticket accounting system, however, was anything but automated. When passengers turned in tickets, the flight coupons were stuffed into envelopes by gate agents and shipped back to Northwest's headquarters. There they were stored in a warehouse stacked to the ceiling with cardboard filing boxes.

The problem facing Northwest—and every other airline—stemmed from the



BRISTOL MEYERS' GILSON started out with a nonstrategic imaging application as a way to minimize risk in case of failure.

fact that passengers use tickets in a way that bears only a passing resemblance to the electronic records housed in the ticket database. They may use a ticket from one airline to fly with another, or they may use only the A-B leg of an A-B-C flight. Because of the discrepancies between original ticket records and actual ticket use, airlines need to match every flight coupon in the warehouse against every ticket in the database to accurately calculate passenger revenues.

Deregulated Complications

Further complicating revenue accounting is the deregulated airline environment, in which daily price changes can affect as many as 1 million tickets. Given the number of passengers carried by Northwest, a manual match for every ticket was clearly impossible. "Instead, we took a sampling of tickets and used a statistical-modeling program to essentially estimate revenues," explains Harold Atkins, assistant controller at the airline.

But this shortcut left much to be desired. For one thing, revenue estimates were not always accurate. Nor did they alleviate the paper problem, since tickets still had to be physically tracked down in the warehouse and pulled each time a fare refund or interairline transfer was required. Of the 600 people employed in Northwest's passenger revenue accounting office, 20 did little else but search for flight coupons.

> ☐ **Instead Of Chasing Paper, Workers Will Be Reassigned To More Useful Jobs.**

So, in 1986, following its merger with Republic Airlines, Northwest realized it had to streamline the process. It hired Chicago-based Andersen Consulting to design an automated Passenger Revenue Accounting (PRA) system. The assignment proved to be an archetypical systems integration job: by the time Andersen sought out the best components for each system element, at least 10 vendors were involved.

From an imaging standpoint, a key element of the PRA is a scanner from Recognition Equipment Inc. of Irving, Texas, that was specially engineered to read 17 tickets per second. Once the ticket images are captured and indexed by ticket number, the images are stored in an optical storage and retrieval library from FileNet Corp. of Costa Mesa, Calif. The optical library consists of two jukeboxes, each containing 204 twelve-inch optical discs and can house a maximum of 40 million documents.

Another key element of the PRA system is a network of workstations from Sun Microsystems Inc. used to access ticket images. Each ticket number is scanned by optical character recognition (OCR) software and then sent to a Sun fileserver. The system uses the relational database management software from Sybase Inc. of Emeryville, Calif., to keep track of the location of each ticket image in the FileNet library.

Special audit software from Los Angeles-based Inference Corp. matches the ticket image in the library with ticket records on the mainframe database. For those cases where audit errors are detected, the ticket in question is fetched from the FileNet library and put in a queue to await further auditing by operators working at the Sun workstations. "The ticket retrieval process—which used to take hours—is now done in seconds," says Rachel Hollstadt, director of the PRA system.

Northwest's application is being touted by some as a vision of the imaging future. "Historically, image applications have been confined to document management with some limited connections between the document storage system and host data," says FileNet's vice president of marketing, Bob Castle. "The [Northwest application] represents a much broader use of image. Different databases, different data types, expert systems, a number of different software technologies are all tied together at the workstation level using a client/server, open systems architecture."

For IS directors contemplating image applications, Northwest's PRA does indeed illustrate the technology's potential. But it also serves to highlight some of the scarier aspects of integrated image systems today. For starters, there is the matter of sticker shock. Northwest won't disclose the cost of the system, but educated guesses put the total tab in the range of $50 million, counting hardware, software, development and training costs.

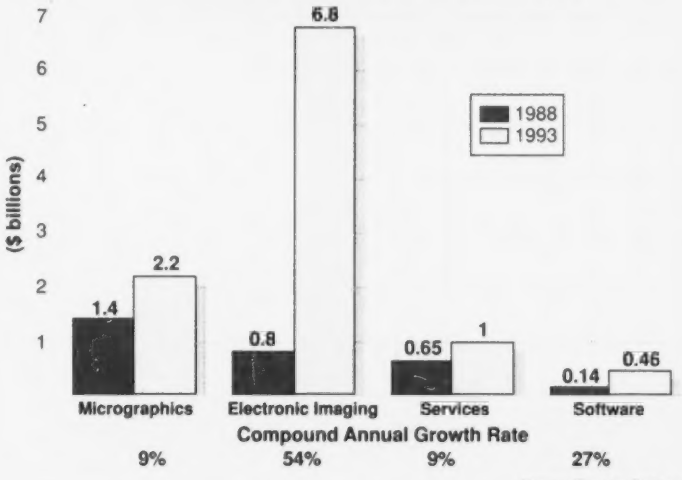
While not acknowledging the accuracy of the $50 million estimate, Doug Schwinn, then senior director of IS development at Northwest (he has since moved to Dayton Hudson Corp.), who headed up the project, says the cost figures merit some qualification. The total PRA system includes a number of pieces, he says, including a new IBM mainframe and specially developed accounting software to run on it. To that add the costs of expert system audit software and an upgraded data center network. According to Schwinn, the parts of the system directly related to imaging account for only about 10% of the total cost.

By another measure, the image portion of the system—including scanners, workstations, network and servers—comes to about $11,000 per workstation, according to Tom Grudnowski, the partner at Andersen Consulting who led the PRA project team.

Price appears not to be a major concern to Northwest: the airline expects to recoup the costs within the first year through greater employee efficiency and other savings. "Instead of chasing paper, workers will be reassigned to more useful jobs, such as doing audits," explains PRA director Hollstadt. An even greater payoff will come in the form of improved market intelligence. "For the first time,

The Imaging Market Is Looking Good

Electronic-imaging sales are expected to grow a breathtaking 54% each year over the next five years.



Source: Temple, Barker and Sloan

Northwest will be able to know what its true customer base is and where those customers fly," says Schwinn.

There is another aspect to the Northwest system that may give some IS directors pause, and that is the amount of customization required. At the point of peak activity, some 180 people worked on the PRA system. Many of them were part of the software development effort to build in auditing features and integrate the image capture and storage system into the mainframe ticket database. But a sizable chunk of development time was also devoted simply to tying the various hard-

☐ EXPERTS AGREE THAT STANDARDS ARE NO LONGER A MAJOR STUMBLING BLOCK.

ware pieces together. "One of the biggest challenges of the project was to get all the components running at the speed of the scanner," admits Schwinn.

The Integration Question

Integration—how much is needed and at what cost—is a major question in the imaging arena these days. How much customization work is needed to make image technology fit an organization's needs? Depending on the particular application, the answer can be a lot, as the Northwest system shows. But even less-specialized applications will generally require the assistance of a systems integration company.

"There is no single-product company today that gives an optimal solution," says Brendan Reidy, vice president and general manager of Litton Integrated Automation in Alameda, Calif., one of a number of integrators doing a brisk business in building large imaging applications. Reidy points out that for a large imaging system—$10 million and up—roughly one-third of the final cost typically goes to the systems integrator for consulting and integration work. Integration fees often include the programming of entirely new applications or, at the very least, software to link the image system to an existing application.

In many cases, more fundamental integration problems need to be solved. Depending on the needs of an application, it may be necessary to write device drivers for printers, scanners or optical disc systems just to link the various imaging components together. Then there is the issue of linking the imaging components to other computers and databases.

Who Needs Imaging, Anyway?

In 1987, J.C. Penney Co. Inc.'s Credit Division in Dallas decided to consolidate from 13 new account application centers across the country into just three. The plan hinged on the use of image processing to eliminate the flow of paper. "It would have been tough to consolidate without image; it would have meant a lot of people under one roof," says project coordinator James Worthy.

But even before moving to the image-based new accounts system, Penney had already realized substantial benefits from imaging technology. Using an image-based remittance-processing system built in the mid-1980s by TRW Financial Systems Inc. of Berkeley, Calif., Penney routinely handles over 11 million items a month. Yet its labor force is 40% smaller than the older, nonimage system required.

Based on this success, the company is moving ahead with plans to expand its use of imaging. In addition to the image-based new-accounts applications, Penney is planning to install a document image system for all customer correspondence. "Image has been very successful for us; we have a lot of confidence in the technology," says Worthy.

Buoyed by reports of this kind of return, some industry observers are predicting a surge in image processing. In a study for the Association for Information and Image Management (AIIM), Temple, Barker & Sloane Inc. (TBS), a research firm in Lexington, Mass., estimates that the market for electronic-imaging systems will grow at a compound annual rate of 54%. "Electronic imaging may not be the hottest growth market, but it is right up there with some of the hottest, including fax machines, cellular phones and engineering workstations," says Mark Bruneau, a senior associate with TBS.

Other analysts predict the market growth will be slower, limited to high-volume applications such as J.C. Penney's remittance system. "My own guess is that there is something in the neighborhood of 600 high-volume, transaction-processing types of applications that can really justify the cost of a $4 million image system," says Stuart Woodring, director of software strategy for Forrester Research Inc. in Cambridge, Mass.

At $10,000 and up for a high-end imaging workstation, it's tough to cost justify many desktop or departmental image systems. Even image vendors concede that the cost of workstations will have to come down before imaging storms the office the way personal computing did.

The real market for imaging is probably outside the office, in industries such as printing, publishing and health care, says Lawrence Matteson, vice president and general manager of Eastman Kodak Co.'s Imaging Information Systems Group in Rochester, N.Y. At the same time, Matteson believes it may be hard to keep imaging out of the office. "Look what happened to fax. It exploded when electronic mail became available because people wanted images, not ASCII characters."

For now, would-be image users are having a tough time finding image systems at departmental or work group prices. "What we have are a number of departmental problems that could be solved very nicely by image," says Alan Gilson, director of technology assessment at Bristol-Myers Squibb Co. "What we don't have are a lot of high-volume applications that can justify bringing image in at a cost of several million dollars. But so far no one has quoted us a system that does what we need for a price we can afford."

For a number of years, standards for optical storage—or the lack of them—were a subject of concern, with discussion typically focusing on such things as data compression/decompression standards and optical-writing techniques. Today, many experts agree that standards are no longer a major stumbling block. Standards for compression/decompression do exist, and standards for interchange of data among optical systems are developing.

To what extent vendors will support these standards remains a valid concern. But whether vendors go their own way on things like compression/decompression and optical writing is not the major hindrance to integrated imaging.

"Data formats for optical disc are irrelevant," maintains Roger Sullivan, vice president of image management systems at BIS/CAP International, a market research firm in Norwell, Mass. "Most customers are making decisions well beyond the question of what are the nuts and bolts of data format or whether they can move data from one optical disc to another. Integration within the data-processing environment is the primary concern. What customers really want is to intercept the data stream on the host or to have the host system automatically retrieve documents from an image system and do something with it."

Even a modest imaging project can easily run into difficulties. For instance, piecing together the various hardware and software elements can be especially

problematic. Two years ago, Bristol-Myers Squibb Co. of East Brunswick, N.J., undertook a project involving the conversion of all internally developed research and development documents in its Princeton, N.J.-based Research Information Center (RIC) from microfilm to an optical storage and retrieval system.

Risk-Free Conversion

One reason for doing the project was to learn more about the technology. "Down the line, we have some ambitious plans for image, but this [project] was not one of them," says Alan Gilson, manager of the firm's Technology Assessment Group. Gilson terms the RIC project a production pilot that "posed no real risk to the company if the conversion failed."

Just as well, because, says Gilson, "what we learned is that integrating image is a lot more difficult than it needs to be." For example, problems cropped up when the implementers tried to use a session number from a database management system running on a VAX minicomputer as an index number to access an image document. "Sun workstations offered an implementation that was better than other vendors," says Gilson. "Even so, it was clumsier than it needed to be. Operators have to use Sun tools to transfer from the DEC terminal to an imaging session on the Sun server. That should be an automatic transfer; it shouldn't require human intervention."

How long will it take image vendors to develop the kinds of integration that users want? The answer depends on whether this technology truly poses unique challenges or whether it can benefit from the steep learning curve that other IS technologies have followed.

Some experts believe that image applications do pose special challenges. "Architectural issues for image are very different than for data," says Scott McReady, director of image systems for IDC/Avante, a Framingham, Mass., research firm. "They are much more complicated than most users, or many vendors, realize. One vendor may use a proprietary server architecture to handle high-volume I/O; another may opt for a different solution. Then there's a whole host of back-end storage issues and workstation design issues." According to McReady, the solution for one application will generally not be the optimal solution for another.

But this view is not shared by all—and certainly not by the image vendors. "I don't believe image technology requires a higher degree of customization than other new technologies have," asserts David Sarna, president of New York City-based Image Business Systems Inc. "But image is new technology, so people are puzzling through how to implement it with existing technologies. That means they often come up with a detailed requirement that isn't necessarily the ideal solution. It just happens to be the way they solved the puzzle."

Prevailing Platforms

Sarna predicts that, over time, a small number of accepted image platforms and approaches will prevail. He offers the analogy of building one's own database management system: "Today you'd have to be out of your mind to even consider it, but several years ago it was thought to be a reasonable question."

The challenge of piecing together imaging solutions has mainly fallen to systems integrators, many of which have standardized on a particular set of products that they use as a basic imaging platform. Litton Integration Automation, for instance, typically uses as its solution a standard platform consisting of an IBM mainframe, Sun workstations, a high-speed fiber optic backbone and a mix of printers and scanners.

□ INSTEAD OF HARPING ON TECHNOLOGY, THE IMAGE INDUSTRY IS SINGING SONGS OF SOLUTION.

The image vendors now appear to be following this lead by offering standard solution platforms, mainly through a flurry of vendor alliances. Image Business Systems, for instance, offers a package consisting of IBM RT workstations (to be replaced by RS/6000s later this year); optical drives from Laser Magnetic Storage International Co. of Colorado Springs; jukeboxes from Cygnet Systems Inc. of San Jose; OCR scanners from Santa Clara-based Calera Recognition Systems Inc.; Ethernet, Token Ring and fiber-optic networking solutions from a variety of sources; and IBS' own bar code software.

Indeed, there appears to be a real scramble to form alliances. Unisys Corp. recruited at least 10 suppliers—including FileNet, Plexus Software Inc. (also in Santa Clara) and Sigma Imaging Systems Inc. of Anaheim, Calif.—for its general purpose imaging product called InfoImage Folder, introduced earlier this year. Similarly, IBM offers a set of its own and third-party products as building blocks for its AS/400-based imaging system. "We think this approach takes a lot of complexity out of the equation for the customer," says Craig Grant, IBM's manager of AS/400 market development specializing in image applications.

With imaging technology moving so fast, the vendor alliance approach represents in some respects a compromise solution. "We've got a platform that offers basic functionality, but if you have an application that needs the latest and greatest and fastest of a certain type of device, we may not support it today," says Grant.

Of course, there is no guarantee that the rash of vendor alliances will meet the specialized needs of many potential customers. David Coldren, executive director of the Illinois Criminal Justice Information Authority, has a case in point. "I've watched the technology get better and better, and now I'm seeing vendors and systems integrators put the pieces together. But no one has put them together in a system that meets our needs."

What Coldren has in mind is a unique system for storing and retrieving electronic images of court records. It would need to be a big system, he figures; Illinois has millions of court records on file, and the file for the average felony case is 3 inches thick. "There's a lot of information in those files that could have relevance to other criminal cases, if only we could get at it," says Coldren.

The bureau currently stores court documents on microfilm. Optical storage would improve the retrieval time for entire cases, but it still would not allow for key word retrievals based on the information contained within scanned documents. As yet, few vendors have linked OCR technology to imaging in a way that can accomplish this feat. Moreover, an indexing system that could keep track of all the names, aliases, dates, times, places and other data that might be relevant to a criminal prosecutor would be challenging to build. "We've talked with systems integrators," says Coldren. "They are doing some interesting things. But hiring a systems integrator to invent the missing pieces is too expensive." Nor does systems integration lend itself to the needs of a public agency, which typically must be able to point to a specific product before it can secure money from funding agencies.

"It's nice to see that the imaging pieces are starting to be assembled into vertical solutions," says Coldren. "It just doesn't look like ours is going to be one of the target markets anytime soon." ▭

COMPANY INDEX

This index lists vendors, user groups and industrial associations mentioned in this issue of DATAMATION, excluding those mentioned only in passing. Page numbers refer to the first page of articles.

A
ADM Inc. 41
Alza Corp. 54
Amdahl Corp. 49, 62
American Airlines 49
Andersen Consulting 20, 27
Apollo Computer Inc. 85
Architecture Technology Corp. 54
AT&T 49

B
Bank of America 49
BankAmerica Corp. 69
Banyan Systems Inc. 54
Baxter Healthcare Corp. 49
Beijing Stone Group 79
BIS CAP International 27
The Boeing Co. 49
Boston Business Computing Ltd. 85
Bristol-Myers Squibb Co. 27
Britton-Lee 49
Broadview Associates 35

C
C-Tech Electronics Inc. 85
Calera Systems Corp. 27
Canada Housing and Mortgage Corp. 41
Charles River Data Systems 49
Cisco Systems Inc. 85
Citicorp 49
The Coca-Cola Co. 49
Codex Corp. 85
Compaq Computer Corp. 41, 54
Compass Holdings BD 20
Continental Corp. 69
Convex Computer Corp. 49
Cowen & Co. Institutional Services 41
Cygnet Systems Inc. 27

D
Data General Corp. 35
Datapro Research 35
Dayton Hudson Corp. 27
Deutsche Bundesbahn 41
Digital Equipment Corp. 35, 41, 49, 54, 85
Digital Research Inc. 85
Dynamic Microprocessor Associates Inc. 85

E
Eastman Kodak Co. 20, 27, 69

F
FileNet Corp. 27
FileTek Inc. 49
Forrester Research Inc. 27, 54
Franke Contract Group 54

G
Georgia Dept. of Administrative Services 62
Goal Systems International Inc. 85

H
Hayes Microcomputer Products Inc. 85
Heller Financial Inc. 20
Hewlett-Packard Co. 35, 54, 62

I
IBM 35, 41, 49, 62, 75
IDC/Avante 27
Illinois Criminal Justice Information Authority 27
Image Business Systems Corp. 27
Inference Corp. 27
Intel Corp. 49

J
J.C. Penney Co. Inc. 27

K
Key Tronic Corp. 85

L
LANSystems Inc. 85
Lantronix Corp. 85
Laser Magnetic Storage International Co. 27
Lattice Inc. 35
Legent Corp. 85
Litton Integrated Automation 27
Logic Works Inc. 85

M
Massachusetts Mutual Life Insurance Co. 69
McDonnell Douglas Corp. 49
MCI Communications Corp. 35
McKesson Corp. 41
Metaphor Computer Systems 49
Microsoft Corp. 54, 85
Midland Bank PLC 20
Mitsui 79
Muzak L.P. 20

N
NCR Corp. 49, 85
Netframe Systems Inc. 54
Northwest Airlines 27
Novell Inc. 54
NYNEX Corp. 20

O
Oracle Corp. 49

P
Panasonic Communications & Systems Co. 85
Pekin Stone 79
Pfizer Inc. 35
Plexus Software Inc. 27
Price Waterhouse & Co. 41
The Procter & Gamble Co. 35
Project Software and Development Inc. 85

R
Ralston Purina Co. 20
Real Decisions Corp. 20
Recognition Equipment Inc. 27

S
SAS Institute Inc. 35
Scientific Data Systems 49
Sequent Computer Systems 49
ShareBase Corp. 49
Sigma Imaging Systems Inc. 27
Sony Corp. 27
Southern Steam Inc. 41
SPSS Inc. 35
Sun Microsystems Inc. 27, 35, 54, 85
Sybase Inc. 27
SynOptics Communications Inc. 85

T
Tandem Computers Inc. 49
Tektronix Inc. 85
Temple, Barker & Sloane Inc. 27
Teradata Corp. 49
3Com Corp. 54
Transaction Technology Inc. 49
TRW Financial Systems Inc. 27

U
U.S. West Communications Inc. 49
Unisys Corp. 27, 41

V
Viewpoint Systems Inc. 85
Volvo Data 20

W
Walker Richer & Quinn Inc. 85
Wang Laboratories Inc. 85
Weyerhaeuser Co. 69
Woodson & Bozeman Co. 41

Y
Yankee Group Inc. 54

Z
Zenith Data Systems Corp. 54

ADVERTISERS INDEX

This index lists advertisers in this issue of DATAMATION

	Page	Circle
Amdek	53	21
AT&T/CNO II	10-11	—
AT&T	93	—
Bell Atlantic*	82-83	34
BMC Software Inc.	43	17
Cambex Corp.	84	35
Candle Corp.	59, 88	22, 37
CF Software**	81	32
Cincom/Mantis Div.	9	5
Cincom/Supra Div.	40	16
Cognos Corp.	65	25
Computer Channel	90	38
Delta Tech Corp.	37, 64	15, 24
Digital Equipment Corp.	18-19, 38-39	—
Dun & Bradstreet Software	6-7	4
Exabyte Corp.	13	6
Exide Electronics Corp.	73	28
Hewlett-Packard Network Systems Division	66-67	—
IBM Corp.	51	—
IDEA Courier	46-47	19
Index Technology	74	29
Information Dimensions	45	18
Intergraph	78	31
International Computer Exchange Ltd.**	81	33
International Power Machines	87, 89, 91	36
Landmark Systems Corp.	1	3
Liebert Corp.	17	8
Nantucket Corp.	48	20
Network Systems	29, 31, 33	11, 12, 13
Oracle Corp.	2, 4	—
Popkin Software	26	10
SAS Institute Inc.	C2	—
Software 2000	71	27
Software AG	24-25	9
Sun Microsystems, Inc.	68	26
Syncsort Inc.	14	7
Systems Center Inc.	C4	2
Tymnet	60-61	23
Western Union	77	30
Xerox Corp.	C3, 34	1, 14
Recruitment Advertising	**94-103**	—
Apple Computer		
Central Point Software		
Ciber		
G.E. Aerospace—M & DSO		
U.S.A.A.		

*Regional Advertiser
**Product/Services Mart

Headquarters: 275 Washington St., Newton, MA 02158, (617)-964-3030; telex 127703; fax (617)-558-4506. **New York:** 249 W. 17 St., New York, NY 10011 (212)-463-6524; **Washington, D.C.:** 4451 Albemarle St. NW, Washington, DC 20016, (202)-966-7100; **Central:** 9330 LBJ Freeway, Suite 1060, Dallas, TX 75243, (214)-644-3683; **Western:** 12233 W. Olympic, Los Angeles, CA 90064, (213)-826-5818 582 Market St., Suite 1007, San Francisco, CA 94104, (415)-981-2595; 3031 Tisch Way, Suite 100, San Jose, CA 95128, (408)-243-8838. **International:** 27 Paul St., London EC2A 4JU, England, (44-1)-628-7030; telex 914911. DATAMATION® (ISSN 0011-6963) Magazine is issued twice monthly on the 1st and 15th of every month by Cahners-Ziff Publishing Associates, L.P., 275 Washington St., Newton, MA 02158. Editorial and advertising offices, 275 Washington St., Newton, MA 02158. Annual subscription rates: U.S. and possessions: $69; Canada: $98; Japan, Australia, New Zealand: $180 air freight; $290 air mail; Europe $157 air freight; $250 air mail. All other nations: $157 surface, $250 air mail. Reduced rate for U.S. public and school libraries: $47. Single copy: $10 in U.S. **For Foreign Subscribers only:** send all address changes and correspondence to — Datamation, Cahners Publishing Netherlands, Postbus 9000, 2130 DB Hoofddorp, The Netherlands. FAX # ★ 31-20-6531316 Tel # ★ 31-20-6531171. Circulation records are maintained at 44 Cook St., Denver, CO 80206. Phone (303)-388-4511. Second-class postage paid at Denver, CO 80206 and at additional mailing offices. DATAMATION® copyright 1990 by Cahners-Ziff Publishing Associates, L.P. Reprints of articles are available; contact Frank Pruzina (312)-635-8800. Microfilm copies of DATAMATION® may be obtained from University Microfilms, a Xerox Company, 300 N. Zeeb Rd., Ann Arbor, MI 48106. Printed by Graftek Press Inc. **All inquiries and requests for change of address should be accompanied by mailing label from latest issue of magazine.** Allow two months for change to be made. POSTMASTER: send address changes to DATAMATION®, 44 Cook St., Denver, CO 80206.